PRELIMINARY SURVEY REPORT:

Plating Shop
American Airlines
Maintenance and Engineering Center
Tulsa International Airport
Tulsa, Oklahoma

SURVEY CONDUCTED BY:
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Engineering Control Technology Branch
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Introduction

Several electroplating processes involve recognized occupational health hazards. Potential sources of these hazards include cyanide, various acid mists, and toxic metals such as chromium.

The Engineering Control Technology Branch of NIOSH is conducting a research study to assess and document control methods in the plating industry. Preliminary surveys are conducted to observe the processes and controls in the actual industrial settings and to identify industrial sites which are suitable for in-depth study.

On this preliminary visit, the NIOSH survey team met with Messrs. Dick Heston, Jim Katapodis, T. L. Jarman, and Richard Terhune. Mr. Heston is the manager of this shop area. Mr. Katapodis is a Project Engineer with the Maintenance and Engineering Center. Mr. Jarman, now retired, was the supervisor of the plating shop, and Mr. Terhune is a mechanic in the plating shop.

Description of Facilities

American Airlines' Maintenance and Engineering Center is located on the eastern edge of the Tulsa International Airport, on the northeast corner of the city. The periodic inspection and major maintenance of American's fleet of aircraft is performed here. The capabilities include engine rebuilding, avionics repairing, maintenance of landing gear, and complete refurbishing of aircraft exteriors. The large concrete and steel structure was built and occupied by American Airlines in 1963.

The layout of the plating shop area is diagrammed in Figure 1. The plating shop is a separate room within the building, having approximately 20,000 square feet of floor space and a 40 foot ceiling height. There are six plating lines in the south end of the shop, arranged in three parallel pairs. There are also some tanks in a smaller area in the northeast corner of the shop, and more are being added. The tanks are set on concrete pedestals built up from the concrete ventilation duct tunnels which run underneath each line. There is some work space for masking, fitting fixtures, and light shop work; grit blasting and shot peening are performed in another area. A small laboratory for analyzing plating bath concentrations is located adjacent to the main doorway to the shop.

The aisle floors are concrete but the perimeter of each tank, as well as the area between the two lines on each paired row, is open to the basement and covered by a steel grating. The ventilation ducts run through the basement. Each main branch for the tanks at the south end has a separate vertical shaft to the fans on the roof. The tanks at the north end are on separate systems.

Lines A, B, and C are the three hard chrome lines with a total of 22 plating tanks ranging in size from 62 to 1066 gallons. In addition to the chrome plating tanks, these lines contain alkaline cleaner (A), hot muriatic acid (A & B), vapor degreaser (C), alkaline descaler (C) wax remover (C), and rinse tanks (A, B & C). Some deep tanks for plating hard chrome are being installed at the north end of the room.

Line D contains the electroless nickel and the copper plating tanks, and the cadmium for the nickel/cadmium process. Its other tanks include both acid and alkaline dips and cleaners, an anodizing tank, some coating solutions, and water rinse tanks.

Line E is the nickel line with four nickel plating tanks including a nickel strike tank. There is also a nickel tank on the end of line F. The other tanks in line E are a cyanide strip for nickel, a sulfuric acid etch, a muriatic acid dip, and rinse tanks.

Line F is the cadmium line, having tanks for plating both bright and dull cadmium. There is also a cadmium strip, an alkaline cleaner, and a muriatic acid tank in addition to rinse tanks.

At the time of the survey, twenty-eight workers were employed in the plating shop including two machinists. They were scheduled to work one of two shifts, either 7:00 a.m. to 3:30 p.m. or 3:30 to 11:00 p.m. With this labor force, the plating shop handles about 4000 shop orders per month, with usually one part per order.

Process Descriptions

Before being plated, most pieces undergo some surface preparation. This pretreatment may include grit blasting, shot peening, rust stripping, and cleaning in acid, alkaline, or electrolized baths. Areas not to be treated are covered with a special fixture or masked with a synthetic beeswax or plater's tape. American uses 220 grit aluminum oxide for grit blasting. High strengtn steel is baked at 375^{o}F for 12 or 23 hours to relieve stresses developed during plating. Parts requiring finish grinding are taken to the landing gear machine shop next door.

Chrome plating is accomplished at a rate of 0.0007 inch per hour. The chromic acid concentration of the plating bath is 30 to 35 oz/gal with a 90 to 100:1 mix of chromic acid to sulfuric acid. The current is adjusted to achieve a current density of 2 A/in^{2} of estimated area to be plated. The bath temperature is maintained at 120^{o}F using submerged, steam-heated plate coils as the primary source of heat.

The cadmium plating solutions, both dull and bright, contain from 3.0 to 4.5 oz/gal cadmium oxide and 12 to 18 oz/gal free cyanide. The nickel bath is a sulfamate-type solution containing 10 to 12 oz/gal free nickel. The copper bath, which uses a Rochelle salt, contains 4 to 5 oz/gal copper metal concentration and 1.5 to 5 oz/gal potassium cyanide. The silver plating solution contains 5 to 9 oz/gal silver cyanide and 8 to 12 oz/gal potassium cyanide.

Description of Controls

Almost all the plating and surface preparation tanks are ventilated with slot hoods on two or three sides of the tank, connected to one of the concrete main ducts underneath the tanks. Smoke tube analysis of a number of tanks revealed an excellent degree of capture. A major factor in this control may be maintaining the liquid surface from 8 to 12 inches below the level of the slots, thereby allowing the vapors rising even from the center of the tank

more time to be drawn to the sides. The volumetric flow rates are not known at this time. Neither polypropylene balls nor other surface agents are used to reduce the emission of acid mists.

Work practices observed include draining and rinsing pieces over the plating tanks. Gloves are worn when removing pieces from the acid dip and plating tanks, and the workers wear face shields when working around the nitric acid tank. Safety glasses are to be worn when performing buffing and grinding operations. No other personal protective equipment is required. There is a rule against eating in the shop.

Description of Programs

American employes a consultant for industrial hygiene services whenever needed. Safety is primarily the supervisors responsibility. Meetings are held monthly during which various safety topics are discussed. A plant crew is responsible for ventilation system maintenance. The tops of the tanks, as well as the floors, are cleaned daily by the workers in the plating shop. When OSHA inspected this facility a few years ago, no problems were found in the plating shop.

A full-time physician is on duty during the main shift. He and other trained personnel provide emergency treatment of injuries and illnesses until the employee can be moved to a medical care facility. All employees must undergo a pre-employment physical examination, which is given by the plant physician. Then, once a year, certain diagnostic procedures are given to selected workers. Each worker in the plating shop receives a nasopharyngheal examination, a chest x-ray, and an audiometric screening test.

Conclusions and Recommendations

The local exhaust ventilation system in this plating shop performs exceptionally well. Determining the parameters such as volumetric flow rates, capture velocities, and slot design values is important to our study of control technology in the plating industry. This evaluation should include some chrome tanks, at least one cadmium tank, the nickel/cadmium process, and perhaps the electroless nickel tank and/or an acid tank. Other tanks determined to be particularly well ventilated may also be studied.

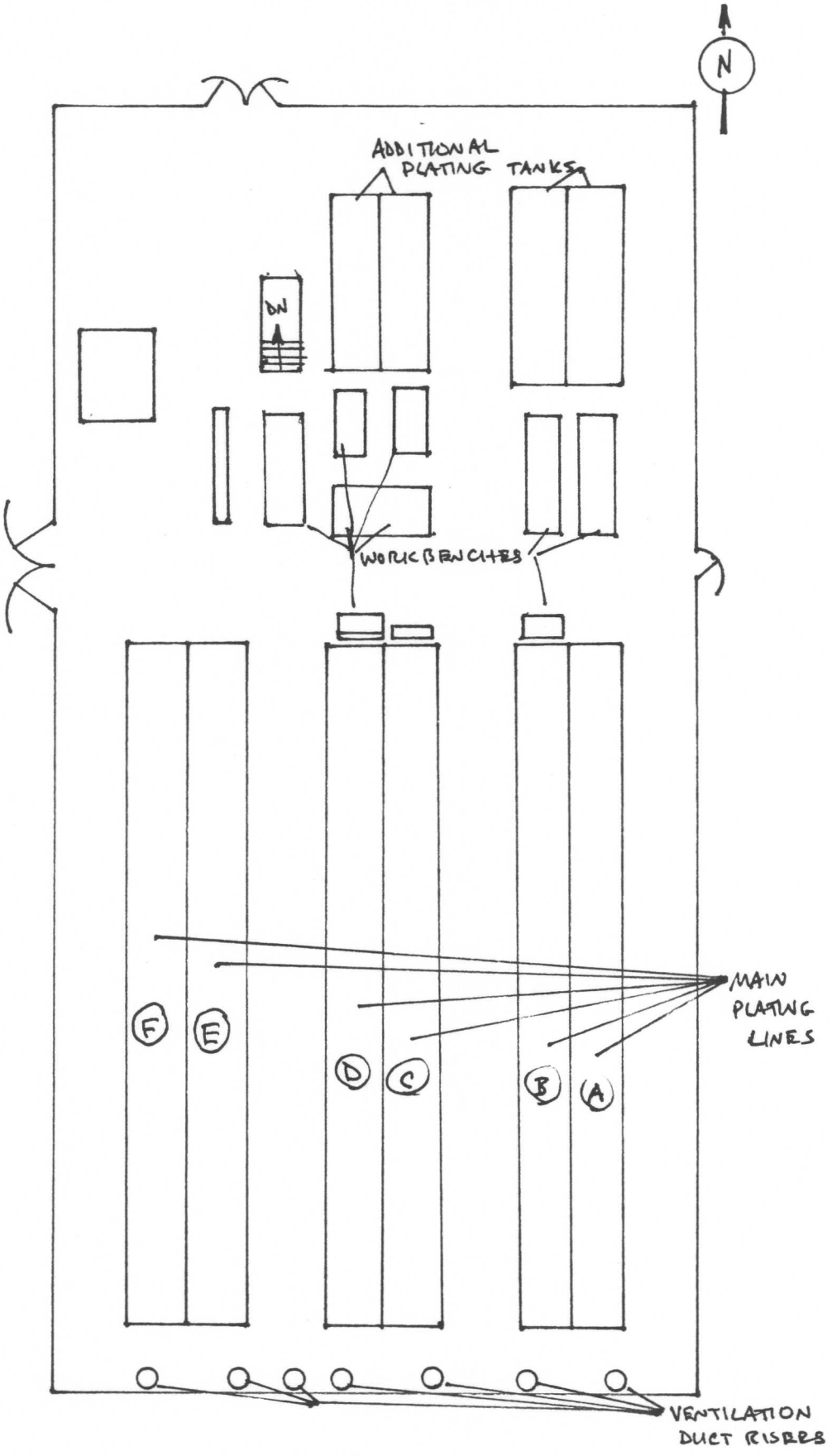

FIGURE 1. DIAGRAM OF AMERICAN AIRLINES PLATING SHOP